Name: _____ **KEY** _____

Date: _____ Period: ____

Solve each polynomial equation by factoring.

1. $5x^3 + 10x^2 + 5x = 0$

$5x(x^2 + 2x + 1) = 0$

$5x(x+1)(x+1) = 0$ $\quad X = 0 \quad X = -1$

2. $(x^3 + 2x^2)(-9x - 18) = 0$ $\rightarrow (x+2)(x+3)(x-3) = 0$

$x^2(x+2) - 9(x+2) = 0$

$(x+2)(x^2 - 9) = 0$

$X = -2, -3, 3$

3. $4x^3 + 40x^2 + 100x = 0$

$4x(x^2 + 10x + 25) = 0$

$4x(x+5)(x+5) = 0$ $\quad X = 0, -5$

4. $8x^4 - 48x^3 = 56x^2$ $\rightarrow 8x^2(x-7)(x+1) = 0$

$8x^4 - 48x^3 - 56x^2 = 0$

$8x^2(x^2 - 6x - 7) = 0$

$X = 0, 7, -1$

Identify the roots of each equation. State the multiplicity of each root.

5. $x^3 + 2x^2 - 3x = 0$ $\quad X = -3 \quad X = 0 \quad X = 1$

$\underbrace{\qquad\qquad}_{\text{multiplicity of 1}}$

$1(x+3)(x-0)(x-1)$

$= 1x(x+3)(x-1)$

6. $2x^3 - 4x^2 + 2x = 0$ $\quad X = 0 \quad\quad X = 1$

$\quad\quad\quad$ mult. of 1 $\quad$ mult. of 2

$2(x-0)(x-1)^2$

$= 2x(x-1)^2$

7. $x^3 - 7x^2 + 11x - 5 = 0$ $\quad X = 1 \quad X = 5$

$\quad\quad\quad$ mult. of 2 mult of 1

$1(x-1)^2(x-5)$

$= 1(x-1)^2(x-5)$

8. $x^3 + 12x^2 + 36x = 0$ $\quad X = 0 \quad X = -6$

$\quad\quad\quad$ mult. of 1 mult. of 2

$1(x-0)(x+6)^2$

$= 1x(x+6)^2$

Use the Rational Root Theorem to identify all *possible* rational roots.

9. $3x^3 + 2x^2 - 1 = 0$ $\quad \dfrac{\pm 1}{\pm 1 \pm 3} = \pm 1, \pm 1/3$

10. $x^4 - 3x^2 + 12 = 0$ $\quad \dfrac{\pm 1 \pm 2 \pm 3 \pm 4 \pm 6 \pm 12}{\pm 1} = \pm 1, \pm 2, \pm 3,$

$\pm 4, \pm 6, \pm 12$

___ $\pm 1, \pm 1/3$ ___

___ $\pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 12$ ___

11. $2x^3 - x - 10 = 0$ $\quad \dfrac{\pm 1 \pm 2 \pm 5 \pm 10}{\pm 1 \pm 2} = \pm 1, \pm 2,$

$\pm 5, \pm 10,$

$\pm 5/2, \pm 1/2$

12. $x^4 + 6x - 9 = 0$ $\quad \dfrac{\pm 1 \pm 3 \pm 9}{\pm 1} = \pm 1, \pm 3, \pm 9$

___ $\pm 1, \pm 2, \pm 5, \pm 10, \pm 5/2, \pm 1/2$ ___

___ $\pm 1, \pm 3, \pm 9$ ___

$2x^3 - 9x^2 + 2 = 0$ $\dfrac{\pm 1 \pm 2}{\pm 1 \pm 2} = \pm 1, \pm 2, \pm \frac{1}{2}$

From graph: $\frac{1}{2}$ ← check with synthetic

$$\frac{1}{2} \big| \begin{array}{cccc} 2 & -9 & 0 & 2 \\ & 1 & -4 & -2 \\ \hline 2 & -8 & -4 & \underline{0} \checkmark \end{array}$$

$\downarrow$

$2x^2 - 8x - 4 = 0$

$x = \dfrac{-(-8) \pm \sqrt{64 - 4(2)(-4)}}{2(2)} = \dfrac{8 \pm \sqrt{96}}{4} = \dfrac{8 \pm 4\sqrt{6}}{4} = 2 \pm \sqrt{6}$

$$\boxed{x = \tfrac{1}{2}, \; 2 \pm \sqrt{6}}$$